

CLAIMS

1. A digital broadcast receiver comprising:

a tuner which amplifies an input signal to select a RF signal on a desired band and amplifies the RF signal to

5 frequency-convert the RF signal into an IF signal;

an orthogonal detector which calculates I and Q complex signals from the IF signal of said tuner;

a demodulator which demodulates a digital signal from the I and Q complex signals of said orthogonal detector; and

10 an automatic gain controller which detects a signal level of a reception signal from the IF signal of said tuner, detects a demodulation state in said demodulator, judges a level of an influence from interference waves in adjacent channels affecting on a demodulation signal on the desired
15 band, generates a gain control signal on a RF band and a gain control signal on an IF band in accordance with the level of the influence and the signal level of said the reception signal, and feeds back the both gain control signals to said tuner.

20

2. A digital broadcast receiver according to claim 1, wherein

said automatic gain controller comprises:

a signal level detector which detects the signal level of
25 the reception signal from the IF signal of said tuner;

a demodulation level detector which detects a demodulation level signal of the demodulation signal on the desired band from a demodulation output of said demodulator;

a demodulation level judgment unit which generates a demodulation level judgment signal representing the influence from the interference waves in adjacent channel affecting on the demodulation signal on the desired channel from the demodulation level signal of the demodulation level detector; and

a control signal generator which generates the gain control signal on the RF band and the gain control signal on the IF band in accordance with the demodulation level judgment signal of said demodulation level judgment unit and the signal level of said signal level detector to feed back the both gain control signals to said tuner, and

said tuner includes:

a RF-AGC amplifier which controls a level of the RF signal on the basis of the gain control signal on the RF band; and

an IF-AGC amplifier which controls a level of the IF signal on the basis of the gain control signal on the IF band.

3. A digital broadcast receiver according to claim 2, wherein

the demodulation level detector includes:

a demodulation band extraction block which extracts a signal on the desired band from a frequency signal Fourier-converted in said demodulator;

5 a demodulation level calculation block which calculates a level of the signal on the desired band obtained in said demodulation band extraction block; and

a demodulation level memory block which retains the level of the signal on the desired band prior to a change of a delay point when a point of switching between the gain control
10 signal on the RF band and the gain control signal on the IF band in said tuner is set to be the delay point, and

said demodulation level detector compares the level of the signal on the desired band prior to a change of a delay point with the level of the signal on the desired band after
15 the change of the delay point to judge the level of the influence from the interference waves in adjacent channels affecting on the desired band.

4. A digital broadcast receiver according to claim 3,
20 wherein

said demodulation band extraction block extracts only a frequency band, on which third-order distortion due to a signal outside the desired band appears.

25 5. A digital broadcast receiver according to claim 3,

wherein

said demodulation band extraction block extracts only a frequency band, on which third-order distortion due to a NTSC signal appears.

5

6. A digital broadcast receiver according to claim 1, wherein

a time axis filter which extracts a signal on the desired band from the I and Q signals of the demodulator is provided
10 between the orthogonal detector and the demodulator,

said automatic gain controller includes:

a signal level detector which detects the signal level of the reception signal from the IF signal of said tuner;

a detection level calculator which calculates a level of
15 the signal on the desired band from an output signal of said time axis filter;

a signal level judgment unit which generates a signal level judgment signal representing the influence from the interference waves in adjacent channels affecting on the
20 signal on the desired band from the level of the signal on the desired band obtained by said detection level calculator and the signal level obtained by said signal level detector; and

a control signal generator which feeds back the gain control signal on the RF band and the gain control signal on
25 the IF band in accordance with the signal level judgment

signal of said signal level judgment unit and the signal level of said signal level detector to said tuner, and

said tuner includes:

a RF-AGC amplifier which controls a level of the RF
5 signal on the basis of the gain control signal on the RF band;
and

an IF-AGC amplifier which controls a level of the IF
signal on the basis of the gain control signal on the IF band.

10 7. A digital broadcast receiver according to claim 1,
wherein

said tuner includes a RF-AGC amplifier which controls a
level of the RF signal on the basis of the gain control signal
on the RF band and an IF-AGC amplifier which controls a level
15 of the IF signal on the basis of the gain control signal on
the IF band, amplifies the input signal to select the RF
signal on the desired band, amplifies the RF signal to
frequency-convert the RF signal into the IF signal, and
generates a adjacent judgment signal representing the
20 influence from the interference waves in adjacent channel
affecting on a signal on the desired band, and

said automatic gain controller includes a control signal
generator which feeds backs the gain control signal on the RF
band and the gain control signal on the IF band to said tuner
25 in accordance with the adjacent judgment signal of said tuner

and the signal level of said signal level detector.

8. A digital broadcast receiver according to claim 7,
wherein

5 said tuner includes, in addition to the RF-AGC amplifier
and the RF-AGC amplifier:

 a first level detection block which calculates a signal
level of a first intermediate frequency signal frequency-
converted into an intermediate frequency;

10 a band limitation filter which limits the band of the
first intermediate frequency signal and converts the first
intermediate frequency signal into a second intermediate
frequency signal;

 a second level detection block which calculates a signal
15 level of the second intermediate frequency signal; and

 a adjacent judgment block which compares the signal
levels of the first and second intermediate frequency signals
to judge the influence from the adjacent interference waves in
adjacent channels affecting on the desired band.

20

9. A digital broadcast receiver according to claim 1,
wherein

 said automatic gain controller includes:

 a C/N detector which calculates C/N from the demodulation
25 signal of said demodulator;

a C/N judgment unit which generates C/N judgment signal representing the influence from the interference waves in adjacent channels affecting on a signal on the desired band from C/N information of said C/N detector;

5 a signal level detector which detects the signal level of the reception signal from the IF signal of said tuner; and

a control signal generator which feeds back the gain control signal on the RF band and the gain control signal on the IF band to said tuner in accordance with the signal level
10 of said signal level detector and the C/N judgment signal of said C/N judgment unit, and

said tuner includes:

a RF-AGC amplifier which controls a level of the RF signal on the basis of the gain control signal on the RF band;
15 and

an IF-AGC amplifier which controls a level of the IF signal on the basis of the gain control signal on the IF band.

10. A digital broadcast receiver according to claim 9,
20 wherein

said C/N detector includes:

a C/N calculation means which calculates C/N information from the demodulation signal of said demodulator; and

a C/N memory means which stores the C/N information of
25 said C/N calculation means, and

AMENDED CLAIMS

J020 Rec'd PCT/PTO 20 OCT 2004

[received by the International Bureau on 03 June 2005 (03.06.2005);
claims 12, 13, 16, 17, 20 and 21 amended; remaining claims unchanged (13 pages)]

said C/N judgment means compares the C/N information
before a change of a delay point with the C/N information
after the change of the delay point to judge the influence
from the interference waves in adjacent channels affecting on
5 the desired band when a point of switching between the gain
control signal on the RF band and the gain control signal on
the IF band in said tuner is set to be the delay point.

11. A digital broadcast receiver according to claim 10,
10 wherein

said C/N detector compares the C/N information calculated
in the C/N calculation means with fixed C/N information
previously stored in a memory.

15 12. (amended) A digital broadcast receiver according to
claim 1, wherein

said automatic gain controller includes:

a state monitor which detects the demodulation state from
a demodulation output of said demodulator to generate a
20 demodulation state signal;

a retainer which retains the demodulation state signal
outputted from said state monitor for a certain period of
time;

a comparator which compares the demodulation state signal
25 outputted from said state monitor with the demodulation state

signal retained by said retainer to output a comparison signal representing a variation of the demodulation state after the elapse of a certain period of time;

a switch unit which determines a variation of a delay point on the basis of the comparison signal of said comparator and the demodulation state signal obtained by the state monitor so as to select a step width of small variation range when the demodulation state is good and a step width of large variation range when the demodulation state is poor, when a point of switching between the gain control signal on the RF band and the gain control signal on the IF band in said tuner is set to be the delay point;

a delay point determination unit which renews a value of the delay point from the variation of the delay point determined by said switch unit;

a signal level detector which detects the signal level of the reception signal from the IF signal of said tuner; and
a control signal generator which generates the gain control signal on the RF band and the gain control signal on the IF band from the delay point value of said delay point determination unit and the signal level of said signal level detector.

13. (amended) A digital broadcast receiver according to claim 12, wherein

28 62

said switch unit includes:

a reception state judgment block which judges a reception state from the demodulation state signal; and

a selection block which determines the variation of the
5 delay point from the comparison result of said comparator and the judgment result of said reception state judgment block.

14. A digital broadcast receiver according to claim 12,
wherein

10 the switch unit includes:

a reception state judgment block which judges a reception state from the demodulation state signal and the delay point value; and

a selection block which determines the variation of the
15 delay point from the comparison result of said comparator and the judgment result of said reception state judgment block.

15. A digital broadcast receiver according to claim 13,
wherein

20 the selection block selects and determines a specific variation of the delay point from a plurality of different delay point variations.

16. (amended) A digital broadcast receiver according to
25 claim 15, wherein

~~70~~ 63

the plurality of delay point variations selected in the selection block include at least one value significantly different from the other variations.

- 5 17. (amended) A digital broadcast receiver according to claim 1, wherein
- said automatic gain controller includes:
- a state monitor which detects the demodulation state from a demodulation output of the demodulator to generate a
- 10 demodulation state signal;
- a retainer which retains the demodulation state signal outputted from said state monitor for a certain period of time;
- a comparator which compares the demodulation state signal
- 15 outputted from said state monitor with the demodulation state signal retained by said retainer to output a comparison signal representing a temporal transition of the demodulation state;
- a switch unit which determines a variation of a delay point on the basis of the comparison signal of said comparator
- 20 and the demodulation state signal obtained in the state monitor when a point of switching between the gain control signal on the RF band and the gain control signal on the IF band in said tuner is set to be the delay point;
- a delay point determination unit which renews a value of
- 25 the delay point from the variation of the delay point

764

determined in said switch unit;

a timing controller which generates a timing control signal which is generated per a period which is several times of period when renewing a value of the delay point in said

5 delay point determination unit;

an optimum delay point retainer which detects an optimum delay point within said period of time from the value of the delay point of said delay point determination unit, the demodulation state signal of said state monitor, and the
10 timing control signal of said timing controller and outputs a value of the optimum delay point for following the changes of reception state;

a signal level detector which detects the signal level of the reception signal from the IF signal of said tuner; and

15 a control signal generator which generates the gain control signal on the RF band and the gain control signal on the IF band from the value of the optimum delay point retained by said optimum delay point retainer and the signal level of the reception signal of said signal level detector.

20

18. A digital broadcast receiver according to claim 17, wherein

said optimum delay point retainer stores and retains an optimum demodulation state within a time period of the control
25 by said timing controller and the value of the optimum delay

7865-

point at that time.

19. A digital broadcast receiver according to claim 17,
wherein

5 said optimum delay point retainer renews the value of the
optimum delay point stored and retained per a time period of
the control by said timing controller.

20. (amended) A digital broadcast receiver according to
10 claim 17, wherein
said switch unit includes:
a reception state judgment block which judges a reception
state from the demodulation state signal; and
a selection block which determines the variation of the
15 delay point from the comparison result of the comparator and
the judgment result of said reception state judgment block.

21. (amended) A digital broadcast receiver according to
claim 17, wherein
20 the switch unit includes:
a reception state judgment block which judges a reception
state from the demodulation state signal and the delay point
value; and

a selection block which determines the variation of the
25 delay point from the comparison result of said comparator and

66

the judgment result of said reception state judgment block.

22. A digital broadcast receiver according to claim 20,
wherein

5 said selection block selects and determines a specific
variation of the delay point from.

23. A digital broadcast receiver according to claim 22,
wherein

10 the plurality of delay point variations selected in said
selection block include at least one value significantly
different from the other variations.

24. A digital broadcast receiver according to claim 1,
15 wherein

said automatic gain controller includes:

a state monitor which detects the demodulation state from
a demodulation output of said demodulator to generate a
demodulation state signal;

20 a retainer which retains the demodulation state signal
outputted from said state monitor for a certain period of
time;

a comparator which compares the demodulation state signal
outputted from said state monitor with the demodulation state
25 signal retained in said retainer to output a comparison signal

8067

representing a temporal transition of the demodulation state;

a synchronous state monitor which detects a synchronous state from the output of the demodulator to generate a control start flag;

- 5 a switch unit which determines a variation of a delay point on the basis of the comparison signal of said comparator, the demodulation state signal obtained in said state monitor, and the control start flag obtained in said synchronous state monitor when a point of switching between the gain control
- 10 signal on the RF band and the gain control signal on the IF band in said tuner is set to be the delay point;

a delay point determination unit which renews a value of the delay point from the variation of the delay point determined in said switch unit;

- 15 a signal level detector which detects the signal level of the reception signal from the IF signal of said tuner; and

a control signal generator which generates the gain control signal on the RF band and the gain control signal on the IF band from the value of the delay point of said delay

20 point determination unit and the signal level of said signal level detector.

25. A digital broadcast receiver according to claim 24, wherein

- 25 the switch unit includes:

8168

a control counter which is reset in response to the control start flag obtained in said synchronous state monitor and executes a counting every time when the variation of the delay point outputted from said switch unit is renewed,

5 thereby counting up a control number;

a state judgment block which judges a reception state from the demodulation state signal, the value of the delay point, and the control number; and

a selection block which determines the variation of the
10 delay point from a comparison result of said comparator and a judgment result of said state judgment block.

26. A digital broadcast receiver according to claim 25,
wherein

15 the selection block selects and determines a specific variation of the delay point from a plurality of different delay point variations.

27. A digital broadcast receiver according to claim 26
20 wherein

the plurality of delay point variations selected by said selection block include at least one value significantly different from the other variations.

25 28. A digital broadcast receiver according to claim 1,

8269

wherein

the automatic gain controller includes:

a state monitor which detects the demodulation state from
a demodulation output of the demodulator to generate a
5 demodulation state signal;

a retainer which retains the demodulation state signal
outputted from said state monitor for a certain period of
time;

a comparator which compares the demodulation state signal
10 outputted from said state monitor with the demodulation state
signal retained in said retainer to output a comparison signal
representing a temporal transition of the demodulation state;

a synchronous state monitor which detects a synchronous
state from the output of said demodulator to generate a
15 control start flag;

a switch unit which determines a variation of a delay
point on the basis of the comparison signal of said comparator,
the demodulation state signal obtained in said state monitor,
and the control start flag obtained in said synchronous state
20 monitor when a point of switching between the gain control
signal on the RF band and the gain control signal on the IF
band in said tuner is set to be the delay point;

a delay point determination unit which renews a value of
the delay point from the variation of the delay point
25 outputted from said switch unit;

~~8370~~

a timing controller which generates a timing control signal for reviewing a value of the optimum delay point per certain period;

an optimum delay point retainer which detects an optimum
5 delay point within a certain time period from the value of the delay point of said delay point determination unit, the demodulation state signal of said state monitor, and the timing control signal of said timing controller and outputs a value of the optimum delay point;

10 a signal level detector which detects the signal level of the reception signal from the IF signal of said tuner; and

a control signal generator which generates the gain control signal on the RF band and the gain control signal on the IF band from the value of the optimum delay point retained
15 in said optimum delay point retainer and the signal level of said signal level detector.

29. A digital broadcast receiver according to claim 28 wherein

20 said optimum delay point retainer stores and retains an optimum demodulation state within a time period of control in said timing controller and a value of the optimum delay point at that time.

25 30. A digital broadcast receiver according to claim 28

wherein

said optimum delay point retainer renews the value of the optimum delay point stored and retained per time period of control of said timing controller.

5

31. A digital broadcast receiver according to claim 28 wherein

said switch unit includes:

a control counter which is reset in response to the
10 control start flag obtained in the synchronous state monitor and executes a counting every time when the variation of the delay point outputted from said switch unit is renewed, thereby counting up a control number;

a reception state judgment block which judges a reception
15 state from the demodulation state signal, the value of the delay point, and the control number; and

a selection block which determines the variation of the delay point from the comparison result of the comparator and the judgment result of the reception state judgment block.

20

32. A digital broadcast receiver according to claim 31 wherein

said selection block selects and determines a specific variation of the delay point from a plurality of different
25 delay point variations.

~~85~~ 72

33. A digital broadcast receiver according to claim 32,
wherein

the plurality of delay point variations selected in said
5 selection block include at least one value significantly
different from the other variations.